NASA SBIR/STTR Technologies

H12.01-9633 - Optical System for Monitoring Net Occular Blood Flow

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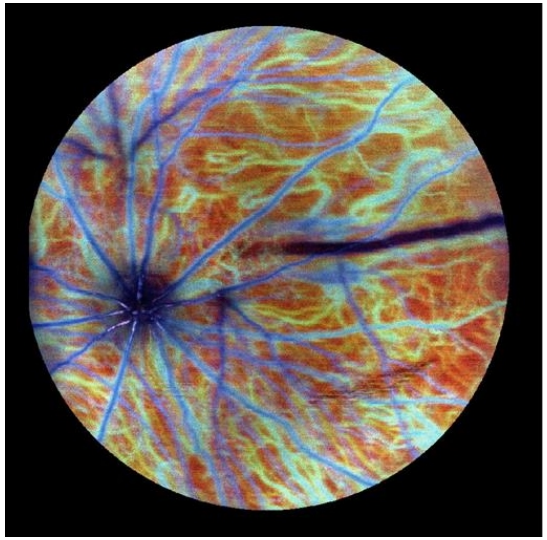
Identification and Significance of Innovation

PSI proposes to develop an advanced new ophthalmic imaging for characterization and monitoring of visual impairment observed in long-duration space flight. We address the requirements for accurate 3D measurement of posterior segment layer thicknesses and volumes, and vascular (retinal and choroidal) topology and flow quantification. The platform will combine non-invasive measurement of retina/choroid structure and blood flow based on Optical Coherence Tomography and flow visualization using Line-scanning Doppler Flowmetry, in the most deeply penetrating waveband (1060 nm). This multimodal approach will yield more and better information by quantitative comparison of mutually guiding and complementary techniques. PSI's prior experience with ophthalmic imaging systems (and space-qualified hardware) leads us to anticipate that the evolution of this single platform can accommodate imaging studies in animals and human subjects, and could be suitable for a future ISS mission.



Estimated TRL at beginning and end of contract: (Begin: 1 End: 3)

Technical Objectives and Work Plan

PSI has a long and successful history in developing advanced ophthalmic imaging instrumentation and we propose to apply these methods for NASA applications. The main objective of the proposed research is development of technology that can characterize the posterior pole of the eye structurally (thickness maps & volume of retina and choroid) and hemodynamically (net blood flow to and from the retina and choroid). PSI proposes to develop a variant of our multimodal imaging systems combining OCT with LSDF. OCT will provide 3D structural information and precise local flow parameters while LSDF flow visualizations will aid in characterizing global blood flow patterns. PSI has extensive experience in developing ophthalmic imaging systems using OCT and proprietary line-scanning techniques. The specific technical objectives that support the overall goal of the Phase I program are:
1. Design a non-invasive imaging system for retina/choroid blood flow measurement. A multimodal imaging system will be designed combining OCT with line-scanning confocal imaging/Doppler flowmetry for structural and hemodynamical characterization of retinal/choroidal layers around the Optic Nerve Head.
2. Develop the Phase II plan for demonstrating the capabilities of the technology. A detailed Phase II plan for building the instrument designed in Phase I will be outlined. This plan will include testing on human volunteers and in small animals in normal and fluid-shift models of micro-gravity conditions.

NASA Applications

There is evidence that fluid shifts and intraocular/intracranial pressure changes observed in microgravity environments produce potential long-term consequences for ocular health. An advanced multimodal imaging platform which can accurately track multiple anatomical and physiological changes in the eye over time is fundamental to understanding these effects and may offer significant advantages to NASA research facilities instead of multiple single-purpose commercial clinical devices.

Non-NASA Applications

The main objective of the proposed research is the development of a multimodal platform combining OCT with PSI's proprietary Line-scanning Doppler Flowmetry that will provide 3D structural information and blood flow parameters. Such a unique platform will have immediate clinical applications including diabetic retinopathy, glaucoma, age-related macular degeneration, and other conditions.

Firm Contacts

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